

CLAIMS

[1] A nitrogen oxide removal equipment for removing nitrogen oxide contained in gas, comprising:

a nitrogen oxide absorption means provided with an absorption unit for removing nitrogen oxide contained in said gas by passing said gas through a solid absorbent layers, said absorption unit comprising:

an absorbent storage part surrounded by a boundary wall of a storage part, a bottom panel of a storage part, and an upper portion of an outlet side, and provided with said solid absorbent layers therein; and

a low-profile unit body provided with a gas rectification part for rectifying gas passing through said solid absorbent layers, and

said unit body comprising:

an intake side surface;

an outlet side surface disposed opposite to said intake side surface and provided with said upper portion of said outlet side and a lower portion of an outlet side;

said storage part boundary wall disposed between said intake side surface and said outlet side surface;

said bottom panel of said storage part disposed horizontally from a lower end of said boundary wall of said storage part to said upper portion of said outlet side;

a bottom of said rectification part disposed below a boundary of an outlet side, i.e., a boundary between said upper portion of said outlet side and said lower portion of said outlet side;

a bottom panel of said intake side extending from said intake side surface to said bottom of said rectification part; and

a bottom panel of said outlet side extending from said boundary of said outlet side to said bottom of said rectification part.

[2] The nitrogen oxide removal equipment according to claim 1, wherein

said intake side surface is provided with an upper portion of an input side and a lower portion of an input side; said bottom of said rectification part is disposed below a boundary of an intake side, i.e., a boundary between said upper portion of said intake side and said lower portion of said intake side; and
said bottom panel of said intake side extends from said boundary of said intake side to said bottom of said rectification part.

[3] The nitrogen oxide removal equipment according to claim 2, wherein said nitrogen oxide absorption means is formed by integrally laminating a plurality of absorption units in a vertical direction;

said unit body is separated from said rectification part by said bottom of said rectification part, said bottom panel of said intake side and said bottom panel of said outlet side, and provided with a rectification part for a lower-stage unit to be said gas rectification part of another absorption unit disposed below when said absorption units are laminated;

a gas intake to said rectification part for a lower-stage unit is provided on said lower portion of said intake side; and

a gas outlet from said rectification part for a lower-stage unit is provided on said lower portion of said outlet side.

[4] The nitrogen oxide removal equipment according to any one of claims 1 to 3, wherein an angle θ between said bottom panel of said intake side and said upper portion of said intake side is in a range of 90 to 180 degrees.

[5] The nitrogen oxide removal equipment according to any one of claims 1 to 4, wherein a ratio of A : B is in a range of 1 : 1 to 1 : 10, where A represents a distance from a boundary between said bottom of said rectification part and said bottom panel of said outlet side to said bottom panel of said storage part while B represents a distance from said boundary to said outlet side surface.

[6] The nitrogen oxide removal equipment according to any

one of claims 1 to 5, wherein said bottom of said rectification part is overlapped with said boundary wall of said storage part in a plane.

[7] The nitrogen oxide removal equipment according to any one of claims 1 to 6, wherein when said absorption units are laminated, said bottom of said rectification part disposed above is overlapped with an upper end of said boundary wall of said storage part of said absorption unit disposed below.

[8] The nitrogen oxide removal equipment according to any one of claims 1 to 7, wherein in case that a removal function of said solid absorbent layer is deteriorated, a regenerant supply means is provided to supply a regenerant to said nitrogen oxide absorption means so that nitrogen oxide absorbed in said solid absorbent layer is removed by said regenerant, thereby regenerating said deteriorated removal function.

[9] The nitrogen oxide removal equipment according to any one of claims 1 to 8, wherein said absorbent storage part and said gas rectification part have water-tightness.

[10] The nitrogen oxide removal equipment according to claim 8 or 9, wherein said regenerant supply means is capable of individually supplying said regenerant to each of said absorption units.

[11] The nitrogen oxide removal equipment according to any one of claims 8 to 10, wherein said regenerant contains a sulfur-containing compound selected from the group consisting of alkali metal hydroxide, alkali earth metal hydroxide, lithium sulfite, sodium sulfite, potassium sulfite, calcium sulfite, magnesium sulfite, iron sulfite, copper sulfite, lithium thiosulfate, sodium thiosulfate, potassium thiosulfate, calcium thiosulfate, magnesium thiosulfate, and a mixture thereof.

[12] The nitrogen oxide removal equipment for removing nitrogen oxide contained in gas comprising: absorption units provided with said plurality of low-profile solid absorbent layers constituting a nitrogen oxide absorption means; and

a gas rectification means for supplying said gas to a large-area side of said low-profile solid absorbent layers of said absorption unit.

[13] The nitrogen oxide removal method for removing nitrogen oxide contained in gas, comprising: a step of introducing said gas into said absorption units provided with said low-profile solid absorbent layers constituting a nitrogen oxide absorption means via a gas rectification means for supplying said gas to a large-area side of said low-profile solid absorbent layers; and a step of selectively removing said nitrogen oxide by using said solid absorbents.

[14] The nitrogen oxide removal method for removing nitrogen oxide contained in gas, comprising: a removal step of removing nitrogen oxide contained in said gas by supplying said gas to a nitrogen oxide absorption means containing a low-profile solid absorbents for absorbing and removing nitrogen oxide via a gas rectification means for selectively supplying said gas to a large-area side of said low-profile solid absorbents; and a regeneration step of regenerating said nitrogen oxide removal function of said nitrogen oxide absorption means, which is deteriorated in said removal step, by removing nitrogen oxide absorbed in said solid absorbents by a regenerant containing a basic or a reducing substance.

[15] The nitrogen oxide removal method according to claim 14, comprising:

a detection step of detecting said removal function by a nitrogen oxide sensor, wherein when deterioration of said removal function is detected in said detection step, said regeneration step is executed.

[16] The nitrogen oxide removal method according to claim 14 or 15, wherein

said regenerant is circulated between said nitrogen oxide absorption equipment and a regenerant tank for storing said regenerant.

[17] The nitrogen oxide removal method according to any

one of claims 14 to 16, comprising:

a preprocessing step for turning nitrogen oxide contained in said gas into nitrogen dioxide, dinitrogen trioxide, dinitrogen quadroxide or dinitrogen quintoxide.

[18] The nitrogen oxide removal method according to any one of claims 14 to 17, wherein said gas is air collected in a tunnel of a road, a canal/an underpath, a shelter of a road, a parking area, nearby a road, or at a bus stop.

[19] The nitrogen oxide removal method according to claim 18, wherein said basic substance is alkali metal hydroxide or alkali earth metal hydroxide, and said reducing substance is a sulfur-containing compound selected from the group consisting of sodium sulfite, potassium sulfite, calcium sulfite, magnesium sulfite, iron sulfite, copper sulfite, lithium thiosulfate, sodium thiosulfate, potassium thiosulfate, calcium thiosulfate, magnesium thiosulfate, and a mixture thereof.

[20] The nitrogen oxide removal method according to claim 19, wherein

when said regenerant contains a reducing substance, said removal function is regenerated in a nitrogen atmosphere.

[21] The nitrogen oxide removal equipment for removing nitrogen oxide contained in gas, comprising:

a nitrogen oxide absorption means for absorbing nitrogen oxide containing low-profile solid absorbents for absorbing and removing nitrogen oxide;

a gas rectification means for selectively supplying said gas to a large-area side of said low-profile solid absorbents;

a regenerant supply means for, when a nitrogen oxide removal function of said nitrogen oxide absorption means is deteriorated, supplying a regenerant containing a basic or reducing substance to said nitrogen oxide absorption means, wherein

said deteriorated removal function is regenerated by removing nitrogen oxide absorbed in said solid absorbents by said regenerant.

[22] The nitrogen oxide removal equipment according to claim 21, comprising:

a nitrogen oxide sensor for detecting said removal function, wherein

when said nitrogen oxide sensor detects nitrogen oxide of a predetermined concentration or higher, said removal function is regenerated.

[23] The nitrogen oxide removal equipment according to claim 21 or 22, comprising:

a regenerant tank for storing said regenerant, wherein said regenerant is capable of being circulated between said regenerant tank and said nitrogen oxide absorption equipment.

[24] The nitrogen oxide removal equipment according to any one of claims 21 to 23, comprising:

a preprocessing means for turning nitrogen oxide contained in said gas into nitrogen dioxide, dinitrogen trioxide, dinitrogen tetroxide or dinitrogen pentoxide, wherein said gas after passing through said preprocessing means is supplied to said nitrogen oxide absorption equipment.

[25] The nitrogen oxide removal equipment for removing nitrogen oxide contained in gas, comprising:

a plurality of absorption units for removing said nitrogen oxide contained in said gas by passing said gas through low-profile solid absorbent layers via a rectification means for introducing said gas into a large-area side of said low-profile solid absorbent layers, said absorption units are provided with a plurality of space-saving-type nitrogen oxide absorption means laminated and integrated in a direction intersecting an extension direction of said solid absorbent layers.

[26] The nitrogen oxide removal equipment according to claim 25, wherein

each of said absorption units is provided with a control means for controlling a flowing rate of said gas passing through said solid absorbent layers.

[27] The nitrogen oxide removal equipment according to claim

25 or 26, comprising:

a regenerant supply means for, when a removal function of said solid absorbent layer is deteriorated, supplying regenerant to said nitrogen oxide absorption means, wherein nitrogen oxide absorbed in said solid absorbent layer is removed by said regenerant, thereby regenerating said deteriorated removal function.

[28] The nitrogen oxide removal equipment according to claim 27, wherein

said regenerant supply means is capable of individually supplying said regenerant to each of said absorption units.

[29] The nitrogen oxide removal equipment according to any one of claims 25 to 28, comprising:

a preprocessing means for turning nitrogen oxide contained in said gas into nitrogen dioxide, dinitrogen trioxide, dinitrogen tetroxide or dinitrogen pentoxide.

[30] The nitrogen oxide removal equipment according to any one of claims 25 to 29, wherein said regenerant is a sulfur-containing compound selected from the group consisting of alkali metal hydroxide, alkali earth metal hydroxide, lithium sulfite, sodium sulfite, potassium sulfite, calcium sulfite, magnesium sulfite, iron sulfite, copper sulfite, lithium thiosulfate, sodium thiosulfate, potassium thiosulfate, calcium thiosulfate, magnesium thiosulfate, and a mixture thereof.

[31] The nitrogen oxide removal equipment for removing nitrogen oxide contained in gas, comprising:

a humidifying means for humidifying said gas; and

a nitrogen oxide absorption means for removing said nitrogen oxide contained in said gas by passing said gas through low-profile solid absorbent layers via a rectification means for introducing said gas into a large-area side of said low-profile solid absorbent layers, wherein

said humidifying means is integrated with said nitrogen oxide absorption means so as to overlap with said solid absorbent layers in a plane, and said gas after passing through said humidifying means is supplied to said nitrogen

oxide absorption equipment.

[32] A nitrogen oxide removal equipment according to claim 31, comprising:

a water tank for storing humidifying water used by said humidifying means, wherein

when a regenerant is supplied onto said solid absorbent layers, said regenerant after passing through said solid absorbent layers is supplied to said water tank, said solid absorbent layer is formed by solid absorbents containing a carbon material; and said regenerant is a sulfur-containing compound selected from the group consisting of alkali metal hydroxide, alkali earth metal hydroxide, lithium sulfite, sodium sulfite, potassium sulfite, calcium sulfite, magnesium sulfite, iron sulfite, copper sulfite, lithium thiosulfate, sodium thiosulfate, potassium thiosulfate, calcium thiosulfate, magnesium thiosulfate, and a mixture thereof.